Combined wheat straw-sawdust biosorption of Selenium using a continuous column setup

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Pollution from metal ions from mining effluent is a current and real environmental pollution problem in mining sites worldwide (Bajaja et al., 2011). High levels of the oxyanion forming chalcogenic element Selenium (Se, G16) in the effluent are forming a present danger for the environment. A lot of techniques are available for the removal of Se from the effluent (Sandy et al., 2010) but there is need for an economical and sustainable treatment solution. An industrial scale setup could be a desirable addition to the now existing technologies for removal, such as chemical precipitation, chemical coagulation, membrane filtration, etc. These existing technologies all have several disadvantages ranging from high costs, low efficiency to disposal problems or implementation problems (Farooq et al., 2010). The principle of pollutants adsorption from effluent is often applied using a column setup to decrease the level of heavy metals in solution (Muhamed et.al, 2010) .Adsorption using biomass as and adsorbent is usually referred to as biosorption. In this study, a continuous down flow fixed column consisting of fixed packings of wheat straw (WS) and sawdust (SD) for the adsorption of Sodium Selenite (Na_2SeO_3) in solution is used. It must be noted that biosorption using a continuous setup, utilizing agro-industrial waste products such as WS and SD, is a new approach for the treatment of Selenium (Se) in effluent water. Most biosorption studies on WS and SD are on the three big, cation forming, polluting metals, namely Lead (Pb) Mercury (Hg) and Cadmium (Cd) while studies on the anoin forming Selenium (Se) are rare. Despite the fact that biosorption techniques are widely studied, there has not been yet a large scale industrial implementation (Volesky et. al, 2003).

In this study, the WS and SD biosorbents are pretreated and used as packing in individual columns as shown in Figure 1. With a variable up-flow pump the Se(IV) solution was sent through both the columns, while the samples were taken at the end of the setup. To determine the optimal conditions of this process, several parameters were varied, such as concentration [Se], pH, flow rate, temperature and the amount of packing. Also the columns are tested in a serial and parallel setup, and are swapped to examine the difference in biosorption capacity of WS and SD. The isotherm and thermodynamic and kinetic parameters are calculated for possible industrial upscale.

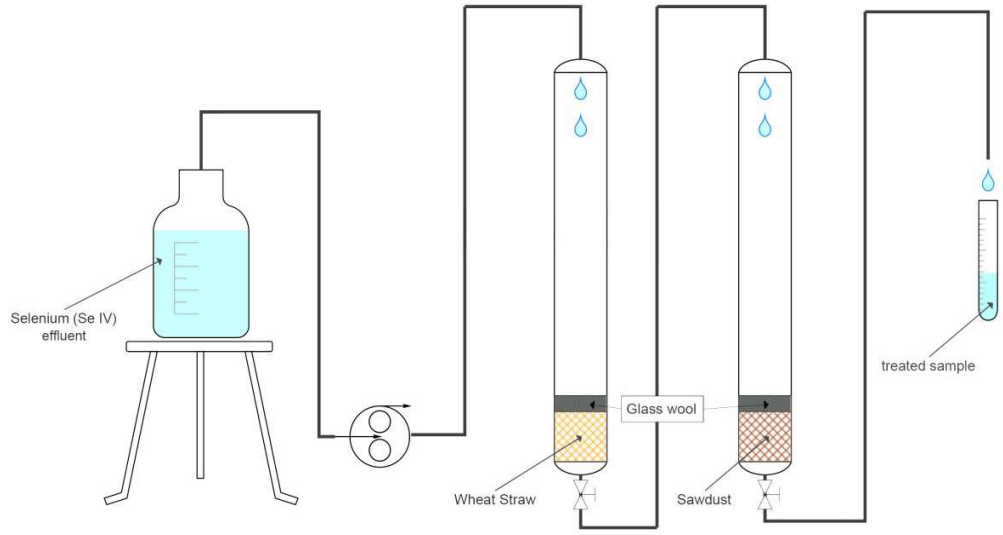

Figure 1: Biosorption process setup for Selenium (Se IV) with WS-SD as biosorbents

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